5.0 POTENTIAL SITE HAZARDS AND CONTROLS

The potential hazards associated with PMC and PMC Subcontractor activities at RMA include safety, chemical, physical, biological, radiological, recovered chemical warfare materiel (RCWM), and unexploded ordnance (UXO) hazards. The possibility of encountering these potential hazards, and the risk to worker health and safety, is dependent on a number of factors including the type of work performed, location and past use of the individual worksite, time of year, equipment used to perform work, and other factors.

The organization performing work is responsible for identifying, evaluating, and controlling potential hazards associated with the tasks and activities that will be performed. Identification, evaluation, and control of hazards associated with individual tasks or activities shall be addressed and documented in the task-specific HASP. Control of hazards for each task is accomplished through performing work in accordance with the PMC HASP and the task-specific HASP. Specific control measures required for field work activities are identified through development of an AHA.

Existing company procedures or written safe work practices may be substituted for AHAs if the potential hazards of the work are identified and appropriate safety precautions and controls are included. The PMC will identify the initial minimum requirements for AHAs and/or safe work procedures in each Subcontract. The Subcontractor or other organization performing work is responsible for identifying the need for, and including, any additional AHAs and/or safe work practices necessary for worker protection prior to conducting work, and as necessary as work progresses. Consideration shall be given to the specific work activities to be performed and location of the work.

Recognized potential hazards and control measures associated with the PMC-related work at RMA are discussed below.

5.1 Safety Hazards

At RMA, safety hazards typical to construction work rather than chemical hazards are the most likely to result in injury to workers. Potential safety hazards for site support services and remediation work are numerous and are present due to the large amount of materials handling, construction, and demolition activities that will take place. Common safety hazards and planned activities that may result in safety hazards include, but are not limited to, the following:

- Walking and working surfaces
- Falls from heights
- Motor vehicle operation
- Heavy equipment operation
- Housekeeping
- Chemical handling and storage
- Demolition operations
- Materials handling (including lifting and shoveling)
- Decontamination Operations
- Hoisting and rigging
- Crane operation
- Electrical work
- Confined space entry
- Trenching and excavation
- Hot work
- Handheld power tools
- High noise operations

Safe work practices and guidelines for these and other potential safety hazards are discussed in Section 16.0, Site Safety Procedures.

5.2 Chemical Hazards

Due to past chemical manufacturing, handling, and disposal operations conducted at RMA, chemical hazards may be present during PMC or PMC Subcontractor activities. Contaminated media include soil, structures, groundwater, surface water, and sediments. Known areas of contamination are shown in Figure 5-1. Properties of the primary contaminants of concern identified through the CERCLA process at RMA are shown in Table 5-1.

Other chemical hazards may be present in work areas depending on the exact site location where the work is being performed. Additional chemical hazards, such as discarded wastes in containers, asbestos-containing material (ACM), polychlorinated biphenyl-contaminated material, lead-based paint, or chemicals brought on-site to perform remedial construction work may be present, depending on the specific job task or location.

The extent of soil contamination and its relative risk to biological receptors has been determined and classified in the ROD for RMA. The three classifications of relative risk are identified as Human Health Exceedance/Principal Threat Soil, Biota Soil, and Priority 1 Soil. For each soil classification, the definition is shown below.

Human Health Exceedance/Principal Threat Soil - A human health exceedance/principal threat soil contains a contaminant or group of contaminants that, through various exposure pathways such as ingestion, inhalation, or skin contact, could result in a health effect to workers in excess of acceptable EPA allowable risks.

Biota Soil - Biota soils contain a contaminant or group of contaminants that may pose a risk to animal populations. The primary risk to biota includes bioaccumulation and biomagnification of contaminants in the food chain. The Biota soils do not exceed EPA's Human Health Risk range.

Priority 1 Soil - Native surficial soil from 0 to 12 inches below the existing ground surface with contaminant concentrations considered to pose a low-level risk to wildlife after remediation of all ROD-specified areas.

Priority 2 Soil – Native surficial soil from 0 to 12 inches below the existing ground surface with contaminant concentrations considered to pose a low-level risk to wildlife lower than Priority 1 soil after remediation of all ROD-specified areas.

Residual Biota Risk Soil – Native surficial soil from 0 to 12 inches below the existing ground surface identified as having potential risk to biota after all ROD-identified remediation is completed. Residual biota risk soil includes Priority 1 soil, Priority 2 soil and other residual risk soil.

These classifications were developed as site cleanup criteria and are not to be used as classifications for determining potential worker exposure. Potential worker exposure and appropriate control measures must be determined when developing the task-specific HASP and AHAs. Factors that should be considered include, but are not limited to, site history, exposure pathways, type of work to be performed, work practices and equipment used, specific chemical compounds detected, and the associated concentration detected in media such as soils.

5.3 Physical Hazards

Potential physical hazards due to site work at RMA will include heat stress, cold stress, and high noise environments.

5.3.1 Heat Stress

Heat stress is a significant potential hazard when performing field work at RMA, especially for personnel wearing protective clothing or when working during the hot summer months. All site personnel should be familiar with the following signs and symptoms of heat stress:

Heat rash - may result from continuous exposure to heat or humid air and is aggravated by the chafing action of clothes. Signs and symptoms include localized reddening of the skin and a decreased ability to tolerate heat.

Heat cramps - are caused by heavy sweating with inadequate fluid and electrolyte replacement. Signs and symptoms include muscle spasms and pain in the hands, feet, and

abdomen. First aid includes oral replacement of fluids and electrolytes.

Heat exhaustion - occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include pale, cool, moist skin, heavy sweating, dizziness, nausea, and fainting. First aid for heat exhaustion includes removing the individual from the hot location, providing rest in a cool area and providing cool liquids to drink.

Heat stroke - is the most serious form of heat stress wherein the body's cooling mechanisms fail and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and, possibly, death occurs. Signs and symptoms are red, hot, usually dry skin, lack of or reduced perspiration, nausea, dizziness and confusion, strong, rapid pulse, loss of consciousness, and coma. Heat stroke is a medical emergency and immediate transport to a medical facility is required.

The PMC and each PMC Subcontractor shall implement heat stress prevention and monitoring procedures during field activities where heat stress is a potential hazard. Heat stress prevention and monitoring will begin at 70°F for personnel wearing impermeable clothing and for other personnel, when the wet bulb globe temperature (WBGT) index exceeds the American Conference of Governmental Industrial Hygienists (ACGIH 2003) Threshold Limit Value (TLV). Heat stress prevention and monitoring programs shall be consistent with the most recent edition of the ACGIH TLV for Physical Agents in the Work Environment, Heat Stress. Refer to Section 7.4.4 for Monitoring requirements.

5.3.2 Cold Stress

Work at RMA may involve field work during periods of low temperature and/or when there is a high wind-chill factor. Cold injury (frostbite and hypothermia) and the impaired ability to work are the potential risks.

Personnel working outdoors in temperatures at or below freezing may become frostbitten. Extreme cold for a short time may cause injury to the surface of the body or result in profound generalized cooling. Areas of the body that have a high surface-area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible.

Localized injuries resulting from cold are included in the generic term "frostbite." Several degrees of damage are possible. Frostbite of the extremities can be placed into the following categories:

Frost nip or incipient frostbite - characterized by initial reddening of the skin, then changing to white. No freezing of tissue occurs.

Superficial frostbite - characterized by skin that presents a waxy or white appearance that is firm, yet resilient to the touch. This condition affects the skin and the tissue just beneath the skin. The skin turns purple and may tingle and burn during warming.

Deep frostbite - characterized by cold, pale, and solid tissue. This condition indicates an extremely serious injury and can result in permanent tissue loss.

First aid for frostbite includes the following:

- Move the person into a warm area.
- Warm the affected area with body heat or warm (not hot) water.
- Do not rub or massage the affected area.
- Seek medical attention.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Symptoms normally progress through five stages: (1) shivering; (2) apathy, listlessness, sleepiness, and sometimes rapid cooling of the body to less than 95°F; (3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; (4) freezing of the extremities; and (5) death.

First aid for hypothermia includes the following:

- Move the person into a warm area.
- Remove any wet clothing and begin to warm the center of the body (torso) with electric blanket if available or body heat under dry blankets, clothing, towels, or sheets.
- Warm, nonalcoholic liquids may be given to a conscious person.
- Seek medical attention.

The PMC and each PMC Subcontractor shall control exposures to cold temperature extremes by implementing cold stress prevention and monitoring procedures appropriate to the field work being conducted when cold stress is a potential hazard. Cold stress prevention and monitoring procedures shall be consistent with the most recent edition of the ACGIH TLV for Physical Agents in the Work Environment, Cold Stress.

5.3.3 Noise

Exposure to high noise levels is a potential hazard associated with the operation of heavy equipment, power tools, generators, compressors, and pumps and similar activities that may be performed by the PMC or PMC Subcontractors. Exposure to steady state or intermittent high noise levels exceeding accepted standards may result in hearing loss.

Wherever noise levels are measured or anticipated to exceed a time-weighted average (TWA) of 85 decibels as measured on the A scale (dBA), worker protection against the effects of noise exposure shall be provided in accordance with 29 CFR 1910.95 or 29 CFR 1926.52 as appropriate. Administrative or engineering controls shall be provided where feasible. If such controls fail to reduce exposure to below 85 dBA TWA, appropriate hearing protection shall be provided and the work area or equipment shall be posted with warning signs to alert workers to the requirement for hearing protection use.

For high noise activities (greater than a TWA of 85 dBA), a written hearing conservation program meeting the requirements of 29 CFR 1910.95 is required and shall be implemented for affected personnel. Refer to Section 7.4.3 for Noise Monitoring requirements.

5.4 Biological Hazards

Activities at RMA involve work around various animals (e.g., prairie dogs, rabbits, mice, and deer), insects, spiders, snakes, and plants. Potential hazards include injuries (scratches and scrapes), stings, bites, and illness due to working in close proximity to plants and disease vectors. Important biological hazards at RMA are discussed below.

5.4.1 Wildlife and Animals

During site operations, animals such as prairie dogs, rabbits, deer, coyotes, mice, and rodents may be encountered. Workers shall use discretion and avoid all contact with animals. If these animals are interfering with site operations, or if dead animals are observed, the USFWS representative at RMA should be contacted for assistance and advice.

Hantavirus - Hantavirus Pulmonary Syndrome (HPS) is a disease that may be contracted when a person comes into contact with Hantavirus-infected rodents, their nesting materials, droppings, urine, or saliva. Hantavirus Pulmonary Syndrome may develop when virus particles are inhaled, absorbed through broken skin or the eyes, or when an individual is bitten by an infected animal. The majority of HPS cases have been reported in the Southwest, however, there is the potential for Hantavirus transmission in most regions with rodent populations. Hantaviruses do not cause apparent illness in their reservoir hosts (rodents and small mammals). Risk to workers at the site is considered to be low; however, the severity of disease is high. Therefore, field personnel should be aware of the potential for exposure and should avoid coming into contact with rodents or their burrows or dens. Precautionary procedures based on Centers for Disease Control guidelines regarding hantavirus prevention will be implemented for cleaning or working in rodent-infested areas.

Rabies - Rabies is an acute, infectious, often fatal viral disease transmitted to humans by the bite of warm-blooded infected animals. This disease affects the central nervous system of humans. A rabid animal may be recognized by signs of raging, uncontrollable movement and possible foaming near or at the mouth. The best control method is avoidance of animals that could be rabid. If bitten by a potentially rabid animal, seek assistance from USFWS to capture or trap the animal so that it can be tested for rabies. The bitten individual shall seek medical attention immediately.

Plague - Plague is a disease usually transmitted by rodent fleas. It may cause serious illness in humans. Symptoms usually occur within three to four days and include a rapid rise in body temperature, headaches, and inflammation of the lymph nodes. Control of plague transmission is accomplished by avoiding animals and rodents prone to carrying fleas, such as mice, rats, and prairie dogs. If you have been bitten, and symptoms develop, seek medical attention immediately.

5.4.2 Insects, Spiders, and Scorpions

Insects, spiders, scorpions, bees, and wasps can be prevalent during certain times of the year. Field personnel should try to avoid contact by surveying the area in which they will be walking, standing, sitting, leaning, grabbing, lifting, or reaching. Workers are encouraged to wear insect repellent when working in areas where insects are expected to be a hazard.

Insect bites or stings - Many insects bite or sting, but few can cause serious effects by themselves, unless the person is hypersensitive to contact. Bees, wasps, and hornets may be present during certain times of the year. Hives are prevalent in some buildings and are a hazard to personnel who are hypersensitive. Site personnel with known or suspected sensitivity should carry their “bee sting kit,” which normally includes antihistamine and epinephrine to counter anaphylactic reactions. This information should also be provided to the HSS and disclosed on the Emergency Data Sheet as discussed in Section 11.

Black Widow spiders - The black widow spider has a shiny black body about the size of a pea, and has a red or yellow hourglass-shaped mark on its abdomen. It weaves shapeless webs in undisturbed areas, such as woodpiles. A bite may result in severe pain, illness, or death (usually from complications and not from the bite itself). Only the female is poisonous; the male is harmless.

Scorpions - Several types of scorpions are native to Colorado. Scorpions may be brown to yellowish in color and range from 1/2 inch to 8 inches in length. They are most active at night. Most species do not inject a toxin that is harmful to humans. The sting may result in local swelling and discoloration, similar to a wasp sting, and may cause an allergic reaction. The sting of the more dangerous species of scorpions causes little or no swelling or discoloration, but locally there will be a tingling or burning sensation. Death, although unlikely, occurs occasionally in infants, young children, and older persons.

Rocky Mountain Spotted Fever - Bites of wood ticks may result in the transmission of Rocky Mountain Spotted Fever, a serious and possibly fatal disease caused by the Rikettsia virus. The Rikettsia virus infects wood ticks, which may bite humans, thereby transferring the virus into the bloodstream. Rocky Mountain Spotted Fever occurs mostly in the late spring and early summer, and is characterized by chills, fever, severe pain in the leg muscles and joints, and a body rash.

Lyme Disease - There is a low risk of Lyme disease in Colorado. Lyme disease is most often characterized with a "bull's-eye" rash, accompanied by nonspecific symptoms such as fever, malaise, fatigue, headache, muscle aches, and joint aches. Personal Protective Equipment offers some protection against insects, but personnel should also perform self-searches at the end of each day to check for ticks if they have been working in areas where ticks may be prevalent.

West Nile Virus – West Nile Virus (WNV) has become prevalent in Colorado. All residents of areas where WNV activity has been confirmed are at risk, with individuals over age 50 considered more vulnerable to the most severe forms of the disease. Most WNV infections are mild with symptoms that can include fever, headache, body aches and, occasionally, skin rashes or swollen lymph nodes. West Nile Virus, however, can also cause encephalitis (inflammation of the brain) and/or meningitis (inflammation of the brain's lining). In rare cases, it can be fatal. Symptoms of advanced WNV may include severe headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, muscle weakness or convulsions. Individuals with these symptoms should seek medical attention immediately. Two types of mosquitos have been identified at RMA. The genus *Culex* is commonly found in the Upper Derby Lake area and other locations containing shallow water, and the genus *Aedes* is common in most other areas of RMA. *Culex* mosquitos breed in still water, and are known carriers (vectors) of disease, including WNV. *Aedes* lay their eggs in moist or muddy soil. Mosquito repellents containing DEET should be applied to open skin areas that may harbor mosquitos. Additional precautions include limiting field activities in areas where mosquitos are prevalent, especially at dawn and dusk, eliminating areas conducive to mosquito breeding (standing water, old tires, etc.), and requesting treatment of mosquito breeding areas.

5.4.3 Snakes

Rattlesnakes are probably the most common poisonous snakes in the West. Of the North American rattlesnakes, the Mojave rattlesnake is the most poisonous; the Sidewinder is the least poisonous. The degree of toxicity resulting from snakebite depends on the potency of the venom, the amount of the venom injected, and the general health, size, and age of the person bitten. Poisoning may also occur from absorption of venom through cuts or scratches. A snake may bite a person and not inject venom. Symptoms and signs of envenomation include the presence of fang marks, rapid and progressive swelling around the bitten area within 5 to 10 minutes, pain, weakness, faintness, nausea and vomiting, and changes in temperature, pulse, and blood pressure.

Snakes should never be moved or handled by field personnel. The USFWS personnel should be contacted if snakes need to be removed from the work area. Precautionary measures for site workers on foot include avoiding walking in grass or underbrush at night, not climbing rocky ledges without visual inspection, and wearing high-top boots and heavy pants. In some instances, where snakes are known to be present, leg protectors or chaps may be necessary to reduce the risk of snakebite. Emergency treatment *does not* include incision through the fang marks. If bitten, the person should be immobilized in a horizontal position with the bitten part lower than the heart. Treat for shock and transport the person to the nearest medical facility.

5.4.4 Bird Droppings

Some structures at RMA contain a significant amount of bird droppings. Inhalation or ingestion of bird droppings may result in several types of diseases, including psittacosis (a communicable disease, with symptoms including headache, nausea, chill and fever, and occasionally, respiratory illness) and histoplasmosis (a fungal disease caused by inhaling spores found in contaminated soils with symptoms that include respiratory distress, fever, chest pains, and a dry nonproductive cough). Work in structures containing significant amounts of bird droppings will require the use of air-purifying respirators and disposable protective clothing.

5.4.5 Plants

The site does not host any plants that are poisonous to humans; however, there are plants that may promote allergic reactions and/or be mechanically injurious, such as cactus. Field personnel shall wear sturdy work clothes and shoes in order to prevent injuries. Existing allergies and sensitivities, which could be aggravated by the work environment, should be reported to the designated HSS and disclosed on the Emergency Data Sheet as discussed in Section 11, so that precautions can be initiated as necessary.

5.5 Chemical Warfare Materiel

The history of RMA involved the military production and handling of several types of chemical warfare materiel (CWM). Known CWM locations are depicted on Figure 5-1. Some CWM may be present in other locations depending on the type of work and exact location of work activities. The primary agents of concern at RMA are blister (mustard [H, HD] and lewisite[L]) and nerve (sarin [GB] and V-agent or VX). Skin contact with these agents or inhalation of agent vapor are the most common routes of exposure. The agent absorption rate is accelerated through unprotected cuts and abrasions.

Mustard may persist in the environment due to low volatility, and may be transferred from a contaminated surface to personnel by direct contact. Mustard readily degrades in the environment through hydrolysis, yet can form a crust-like outer layer that can prevent complete degradation. Minor dermal exposure may result in conjunctivitis and reddening of the skin. Repeated dermal exposure to low concentrations may result in permanent eye damage, blistering of the skin, and tissue destruction. Inhalation of mustard vapor may cause damage to the mucous membranes and upper respiratory tract. Mustard is a known mutagen, teratogen, and human carcinogen.

Nerve agents are moderately persistent substances over time, but readily degrade when exposed to the environment. Exposure to nerve agent causes an increase in acetylcholine throughout the body by its interference with the enzyme cholinesterase. By inhibiting cholinesterase, nerve agents permit acetylcholine to persist within the central nervous system, mimicking the effects of a massive release of acetylcholine. Minor dermal exposure may cause a reaction at the point of contact (e.g., miosis, muscular twitching, or localized sweating). Its absorption via dermal contact or inhalation is sufficient to produce systemic poisoning with the following symptoms (the severity of which will depend upon the degree of exposure): slurred speech, dim vision, chest tightness, increased nasal secretions, sweating, muscular twitching, weakness, nausea, vomiting, diarrhea, coma, and respiratory failure.

The risk of exposure to CWM or RCWM due to nonintrusive activities at RMA is considered to be very low due to degradation or hydrolysis of agents in contact with water or surficial soils over time. The risk of exposure to agents during intrusive activities is low, but will be dependent on the location of work, agent content in subsurface soils, and the type of intrusive activity.

Intrusive activities performed at locations identified as possibly containing chemical agent hazards may require special monitoring, PPE, and decontamination procedures. These requirements will be identified in the Subcontract for tasks in potentially agent-contaminated areas and are required to be addressed in the task-specific HASP.

5.6 Ordnance/Explosive Hazards

The history of RMA involved the use and handling of munitions, ordnance and explosives (OE). During testing periods, munitions and OE were used in various site areas. In some cases, spent and unexploded ordnance may still exist in the soils of these test areas or be located as a lost or misplaced item in a building, manhole, or other aboveground location. Known UXO or OE locations are depicted on Figure 5-1.

Additional information regarding requirements for site evaluations, site UXO procedures, personnel training, response actions, and coordination with other organizations will be provided by the PMC in the Subcontract for work in potential UXO or OE hazard areas. Any UXO or OE requirements identified shall be addressed in task-specific HASPs.

5.7 Radiological Hazards

Radiological contamination or hazards due to past activities at RMA are not anticipated at any of the remedial action sites. Use of radioactive sources (e.g., nuclear density gauges) may be necessary to complete some tasks. Approval by the PMC Radiation Safety Officer and the RVO is required prior to bringing any radioactive source to RMA. Using organizations shall comply

with applicable provisions of PMC Procedure HS-005 (PMC Radiation Safety Program), 10 CFR, 29 CFR, and 49 CFR including source operation and use, posting, labeling, training, material storage, and recordkeeping requirements.

5.8 Crystalline Silica

Crystalline silica compounds such as quartz found in the soil at RMA may present an inhalation hazard during earthmoving activities, including clean construction work. For remediation or clean construction work at RMA, dust control is essential, primarily through wet methods. Spraying water to suppress dust generation during tasks such as excavation and building demolition, and on unpaved roadways, minimizes dust levels and possible exposure to crystalline silica. In tasks where concentrations of respirable silica may not be completely controlled to acceptable levels with wet methods, respiratory protection is worn. Enclosed cabs with air filtration systems on construction equipment typically prevent or minimize exposure to respirable silica, except when high dust levels overload the filtration system. In these instances, changing the filter to a high efficiency particulate air (HEPA) filter can reduce employee exposure to acceptable levels. Real-time air monitoring of dust levels during remediation tasks, combined with personal integrated air sampling, provide ongoing confirmation that control measures such as wet methods, work practices, and PPE are effective in controlling worker exposure.

Figure 5-1. Areas of Contamination

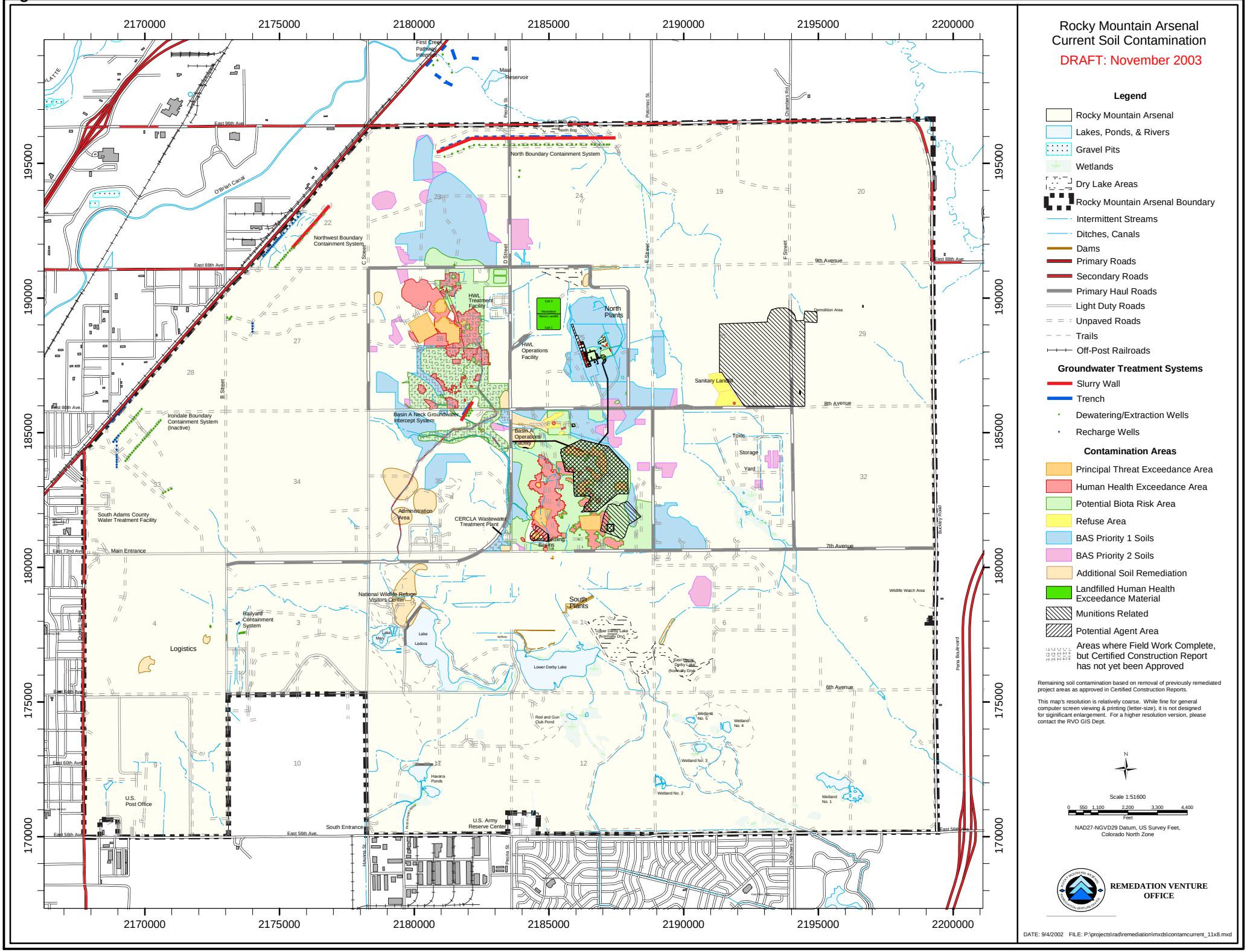

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Table 5-1
Properties of the Primary Contaminants of Concern

Contaminant	PEL	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure: Acute	Signs and Symptoms of Exposure: Chronic	Target Organs	IP	Specific Gravity	VP (mm)	Flash Point	LEL %	UEL %
Aldrin	0.25 mg/m^3 (skin)	0.25 mg/m^3 (skin)	Inhalation Absorption Ingestion Contact	headache, dizziness, nausea, vomiting, twitching muscles, convulsions	CNS, liver, kidney and skin damage, cancer	CNS, Liver, Kidneys, Skin	N/A	1.6	.00008	N/A	N/A	N/A
Arsenic Inorganic PEL = 0.1 mg/m^3	0.5 mg/m^3	0.01 mg/m^3	Inhalation Absorption Contact Ingestion	Ulceration of nasal septum, dermatitis, respiratory irritation	GI disturbances, peripheral neuropathy, cancer	Liver, kidney, skin, lungs, lymphatic system	N/A	5.73	0.0	N/A	N/A	N/A
Benzene	1 ppm	0.5 ppm (skin) 2.5 ppm STEL	Inhalation Contact Absorption	Irritation of eyes, nose, and respiratory system, dermatitis, headache, nausea	Bone marrow depression, anorexia, leukemia	Blood, CNS, skin, bone marrow, eyes, respiratory tract	9.24	0.88	75	12	1.3	7.9
Cadmium	0.005 mg/m^3	0.01 mg/m^3 0.002 mg/m^3 Cpds resp. fraction	Inhalation Ingestion	Dyspnea, nausea, headache, tight chest, pulmonary edema	Cancer, muscle aches, vomiting, diarrhea, kidney, lung damage	Lungs, kidneys, blood, respiratory system, prostrate	N/A	8.65	.0	N/A	N/A	N/A
Carbon tetrachloride	10 ppm (skin)	5 ppm (skin) 10 ppm STEL	Inhalation Absorption Ingestion Contact	Irritation of eyes, skin, respiratory system, CNS depression, drowsiness dizziness, nausea, vomiting	Liver and kidney injury, (known to cause cancer in animals)	CNS, eyes, lungs, liver, kidneys, skin	11.47	1.59	91	N/A	N/A	N/A
Chlordane	0.5 mg/m^3 (skin)	0.5 mg/m^3 (skin)	Inhalation Ingestion Contact Absorption	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, tremors	Lung, liver and kidney damage. (known to cause cancer in animals)	CNS, eyes, lungs, liver, kidneys, skin	N/A	1.6	.00001	N/A	N/A	N/A

Table 5-1
Properties of the Primary Contaminants of Concern (continued)

Contaminant	PEL	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure: Acute	Signs and Symptoms of Exposure: Chronic	Target Organs	IP	Specific Gravity	VP (mm)	Flash Point	LEL %	UEL %
Chloroacetic Acid Chloride	N/A	0.05 ppm	Inhalation Ingestion Contact	Irritation of mucous membranes	N/A	Eyes, skin, respiratory system	10.3	1.42	19	N/A	N/A	N/A
Chlorobenzene	75 ppm	10 ppm	Inhalation Ingestion Contact	Irritation of eyes, skin, nose; drowsiness, incoherence, CNS depression	Liver, lung, and kidney injury	Eyes, skin, respiratory system, CNS, Liver	9.07	1.11	9	82	1.3	9.6
Chloroform	50 ppm (C)	10 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin; dizziness, mental dullness, nausea, confusion, headache, fatigue	Enlarged liver	Liver, kidneys, heart, eyes, skin	11.42	1.48	160	-82	N/A	N/A
Chromium	1.0 mg/m^3	0.5 mg/m^3 0.01 mg/m^3 Insoluble Cr VI	Inhalation Ingestion	GI irritation, nausea, diarrhea	Fibrotic formation in the lungs	Respiratory system	N/A	varies	varies	N/A	N/A	N/A
Dibromochloropropane (DBCP)	0.001 ppm		Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, nose, throat; drowsiness, nausea, vomiting, pulmonary edema	Liver and kidney damage; sterility	Skin, respiratory system, CNS, Liver, kidneys, spleen, reproductive system, digestive system	N/A	2.05	0.8	170	N/A	N/A
Dicyclopentadiene (DCPD)	5 ppm	5 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, nose, and throat; incoherence, headache, sneezing, coughing, skin blisters	Lung damage, kidney, liver damage	Eyes, skin, respiratory system, CNS, kidneys	N/A	0.98	1.4	90	0.8	6.3

Table 5-1
Properties of the Primary Contaminants of Concern (continued)

Contaminant	PEL	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure: Acute	Signs and Symptoms of Exposure: Chronic	Target Organs	IP	Specific Gravity	VP (mm)	Flash Point	LEL %	UEL %
Dichlorodiphenyldichloroethene (DDE)	N/A	N/A	Inhalation Ingestion Contact Absorption	Headache, dizziness, nausea, vomiting, sweating, tremors/jerks, convulsions	Liver and kidney damage; Causes cancer in animals.	Liver, kidneys, CNS, skin	N/A	N/A	$6.5x10^{-6}$	N/A	N/A	N/A
Dichlorodiphenyltrichloroethane (DDT)	1 mg/m^3 (skin)	1 mg/m^3 (skin)	Inhalation Ingestion Contact Absorption	irritation of eyes, skin; paresthesia of tongue, lips, face, tremor, dizziness, confusion, headache, fatigue	liver and kidney damage. Causes cancer in animals.	Liver, kidneys CNS, skin, PNS	N/A	0.99	0.0000002	162-171	N/A	N/A
1,2-Dichloroethane (Ethylene Dichloride)	50 ppm	10 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, CNS depression, nausea, vomiting, dermatitis	Liver, kidney, and CVS damage	Eyes, skin, kidneys, liver, CNS, CVS	11.05	1.24	64	56	6.2	16
1,1-Dichloroethlyene (Vinylidene chloride)	N/A	5 ppm	Inhalation Contact	Dizziness, headache, nausea. Frostbite may occur with skin contact in liquid form.	Liver, kidney damage	CNS	10.29	2.21	35.2 atm.	N/A (Gas)	5.5	21.3
Dieldrin	0.25 mg/m^3 (skin)	0.25 mg/m^3 (skin)	Inhalation Ingestion Contact Absorption	Headache, dizziness, nausea, vomiting, sweating, tremors/jerks, convulsions	Liver and kidney damage; Causes cancer in animals.	CNS, liver, kidneys, skin	N/A	1.75	$8x10^{-7}$	N/A	N/A	N/A
Endrin	0.1 mg/m^3 (skin)	0.1 mg/m^3 (skin)	Inhalation Ingestion Contact Absorption	Epileptic convulsions, stupor, headache, dizziness, abdominal discomfort, nausea, vomiting, confusion, lethargy, weakness	Liver damage	CNS, liver	N/A	1.70	N/A	N/A	N/A	N/A

Table 5-1
Properties of the Primary Contaminants of Concern (continued)

Contaminant	PEL	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure: Acute	Signs and Symptoms of Exposure: Chronic	Target Organs	IP	Specific Gravity	VP (mm)	Flash Point	LEL %	UEL %
Hexachlorocyclopentadiene	N/A	0.01 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, respiratory system; eye, skin burns, lacrimation, sneezing, coughing, dyspnea, salivation, nausea, vomiting	Liver and kidney damage	Eyes, skin, respiratory system, liver, kidneys	N/A	N/A	N/A	N/A	N/A	N/A
Isodrin	N/A	N/A	Inhalation Ingestion Contact Absorption	Malaise, nausea, vomiting, dizziness, tremors, convulsions	N/A	Eyes, skin, respiratory system, liver, kidneys	N/A	N/A	$6x10^{-6}$	N/A	N/A	N/A
Lead	0.05 mg/m^3	0.05 mg/m^3	Inhalation Ingestion Contact	Eye irritation	Weakness, anorexia, tremors, neuropathy, Hypo-tension	GI tract, CNS, kidneys, blood, gingival tissue	N/A	11.34	0	N/A	N/A	N/A
Mercury	0.1 mg/m^3 (C)	0.025 mg/m^3	Inhalation Ingestion Contact Absorption	CNS damage depending on group of mercurial compounds	Same as acute effects	CNS, kidneys, eyes, skin, respiratory system	N/A	13.6	0.0012	N/A	N/A	N/A
Methylene chloride	25 ppm	50 ppm	Inhalation Ingestion Contact	Fatigue, Weakness, numb limbs	CNS damage	Skin, CNS, CVS, eyes	11.32	1.33	350	N/A	14	22
1,1,2,2-Tetrachloroethane	5 ppm (skin)	1 ppm (skin)	Inhalation Ingestion Contact Absorption	Nausea, vomiting, abdominal pain, jaundice, hepatitis, dermatitis	Kidney damage	Skin, liver, kidneys, CNS, GI tract	11.1	1.59	5	N/A	N/A	N/A

Table 5-1
Properties of the Primary Contaminants of Concern (continued)

Contaminant	PEL	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure: Acute	Signs and Symptoms of Exposure: Chronic	Signs and Symptoms of Exposure: Target Organs	IP	Specific Gravity	VP (mm)	Flash Point	LEL %	UEL %
Tetrachloroethylene	100 ppm	25 ppm 100 ppm STEL	Inhalation Ingestion Contact Absorption	Irritation of eyes, nose, throat; nausea, flushed face, vertigo, dizziness, incoherence	Liver damage	Eyes, skin, respiratory system, liver, kidneys, CNS	9.32	1.62	14	N/A	N/A	N/A
Toluene	200 ppm	50 ppm (skin)	Inhalation Contact Absorption	Dermatitis, fatigue, weakness, confusion, muscular fatigue	Insomnia	CNS, liver, kidneys, skin	8.82	0.87	20	40	1.2	7.1
Trichloroethylene	100 ppm	50 ppm 100 ppm STEL	Inhalation Ingestion Contact Absorption	Irritation of the eyes and skin; headache, vertigo, visual disturbances, fatigue, giddiness, tremors, nausea, vomiting, dermatitis	Liver injury	eyes, skin, respiratory system, heart, liver, kidneys, CNS (causes cancer in animals)	9.45	1.46	58	N/A	8	10.5

Notes:
- IP = Ionization Potential
- LEL = Lower Explosive Limit
- UEL = Upper Explosive Limit
- PEL = Permissible Exposure Limit
- TLV = Threshold Limit Value
- mg/m^3 = milligrams per cubic meter of air
- ppm = parts per million
- CNS = Central Nervous System
- VP = Vapor Pressure
- mm = millimeter
- C = ceiling